SEP 14 1981

337

D103.2:Oh3/7/V.13

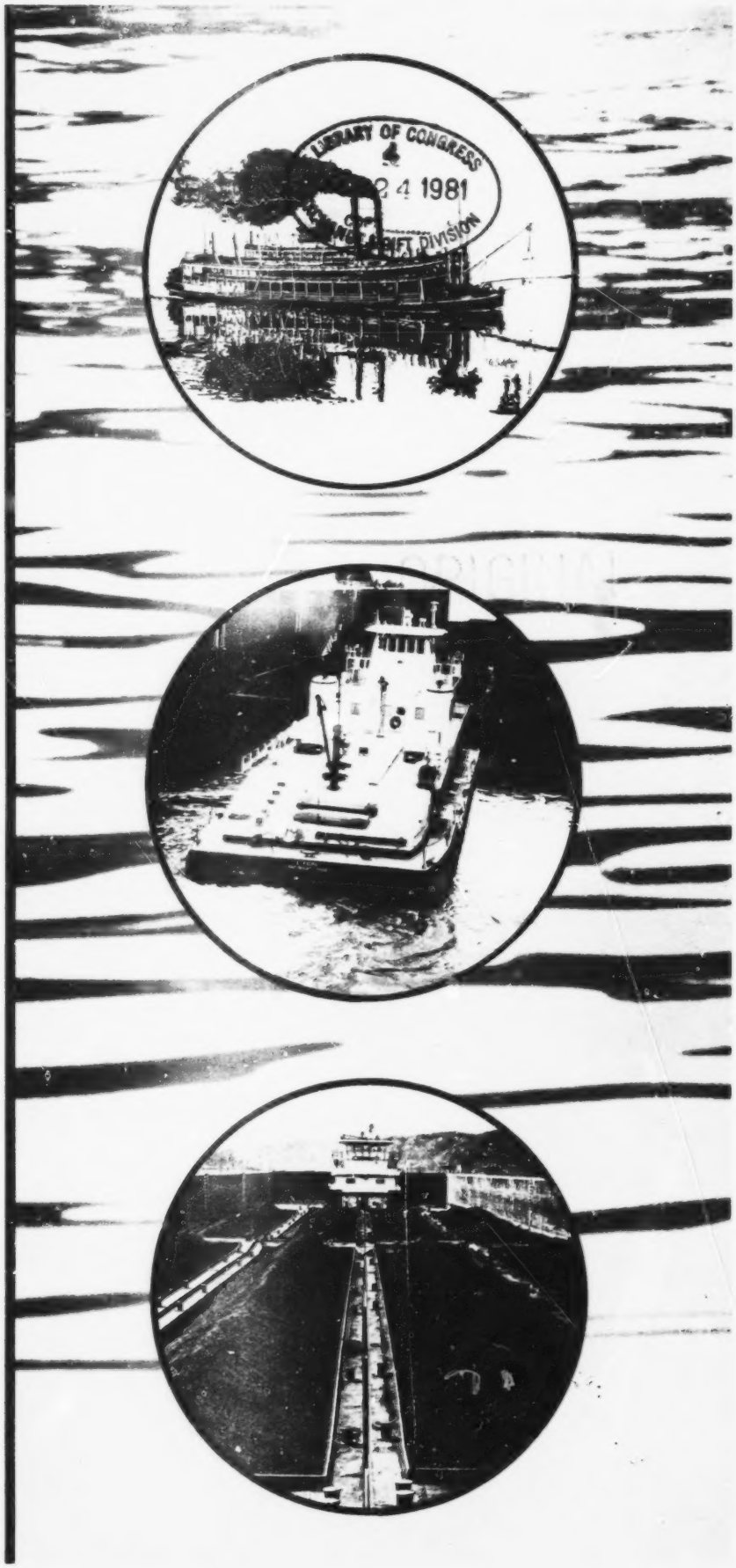
COMPLETED
55

Projections Of Demand For Waterborne Transportation

Ohio River Basin
1980 - 2040

Volume 13

Petroleum Products, Nec.



U. S. Army Corps of Engineers
Ohio River Division
Cincinnati, Ohio

BEST DOCUMENT AVAILABLE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Projections of Demand for Waterborne Transportation, Ohio River Basin 1980, 1990, 2000, 2020, 2040; Vol. 13, Group XI: Petroleum Products, Nec.		5. TYPE OF REPORT & PERIOD COVERED Vol. 13 of 17 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s)		8. CONTRACT OR GRANT NUMBER(s) DACW69-78-C-0136
9. PERFORMING ORGANIZATION NAME AND ADDRESS Robert R. Nathan Associates, Inc. Consulting Economists 1301 Pennsylvania Ave., N.W. Washington, DC 20004		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS Ohio River Basin Navigation Studies
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Corps of Engineers, Ohio River Div. ATTN: Navigation Studies Branch, Planning Div. P.O. Box 1159, Cincinnati, OH 45201		12. REPORT DATE December 1980 13. NUMBER OF PAGES 38
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office) U.S. Army Corps of Engineers, Huntington District P.O. Box 2127 Huntington, WV 25721		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for Public release; distribution unlimited.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Bulk cargo	Market demand analysis	Petroleum products
Commodity resource inventory	Modal split analysis	
Economic development	Ohio River Basin	Petroleum transportation
Economic forecasting	River basin development	
Inland waterways	Traffic surveys	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This Corps of Engineers report describes one of three independent but complementary studies of future freight traffic on the Ohio River Basin Navigation System. Each of the studies considers existing waterborne commerce and develops a consistent set of projects of future traffic demands for all of the navigable waterways of the Basin. Each report contains information on past and present waterborne commerce in the Basin and projections by commodity groups and origin-destination areas from 1976 to at least 1990.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

I

BEST DOCUMENT AVAILABLE

(Continued from #20)
The three study projections, in conjunction with other analytical tools and system information, will be used to evaluate specific waterway improvements to meet short and long-term navigation needs. The output from these studies will serve as input to Corps' Inland Navigation Simulation Models to help analyze the performance and opportunities for improvement of the Ohio River Basin Navigation System. These data will be used in current studies relating to improvement of Gallipolis Locks, the Monongahela River, the Upper Ohio River, the Kanawha River, the Lower Ohio River, the Cumberland River and the Tennessee River, as well as other improvements.

This document is volume 13 of the 17 volume report shown below.

The study included a Commodity Resource Inventory, a Modal Split Analysis and a Market Demand Analysis. The work included investigation and analyses of the production, transportation and demand characteristics of each of the major commodities transported on the Ohio River and its tributaries. For each of 15 commodity groups, the demand for waterway transportation into, out of and within the Ohio River Basin was projected through the year 2040. A detailed study analysis and discussion for each commodity group is presented in 15 individually bound reports, supplemented by a methodology report. A study summary aggregates the commodity group totals for each of the several projections periods and lists the total waterborne commerce for each of the 72 operational locks and dams in the Ohio River Basin. The study results are presented in the following 17 documents:

Volume	Subject Title
1	Study summary
2	Methodology
3	Group I: Coal and coke
4	Group II: Petroleum fuels
5	Group III: Crude Petrol.
6	Group IV: Aggregates
7	Group V: Grains
8	Group VI: Chemicals and chemical fertilizers
9	Group VII: Ores and Minerals
10	Group VIII: Iron ore, steel and iron
11	Group IX: Feed and food products, nec.
12	Group X: Wood and paper products
13	Group XI: Petroleum products, nec.
14	Group XII: Rubber, plastics, nonmetallic, mineral, products, nec.
15	Group XIII: Nonferrous, metals and alloys, nec.
16	Group XIV: Manufactured products, nec.
17	Group XV: Other, nec.

Additionally, an Executive Summary is available as a separate document.

Volume 13 of 17

GROUP XI :
PETROLEUM PRODUCTS, NEC.

PROJECTIONS OF DEMAND
FOR
WATERBORNE TRANSPORTATION
OHIO RIVER BASIN
1980, 1990, 2000, 2020, 2040

Prepared for

U.S. ARMY CORPS OF ENGINEERS
OHIO RIVER DIVISION, HUNTINGTON DISTRICT

Contract No. DACW69-78-C-0136

by

Robert R. Nathan Associates, Inc.
Consulting Economists
Washington, D.C.

DECEMBER 1980

III

A limited supply of this report is available at cost (please prepay, with checks payable to the United States Treasurer) from:

Division Engineer
U.S. Army Engineer Division, Ohio River
ATTN: ORDAS
P.O. Box 1159
Cincinnati, OH 45201

The price of the several documents of the report is as follows:

Executive Summary:	no charge
Volume 1:	$4.00
Volumes 2, 3, 7 and 10:	$3.00 each
All Others:	$2.00 each

The entire set of 17 volumes: $40.00

An unlimited supply of this report will soon be available from:

National Technical Information Service (NTIS)
U.S. Department of Commerce
5285 Port Royal Road
Springfield, VA 22161

Library cataloging information:

Robert R. Nathan Associates, Inc.
Projections of demand for waterborne transportation, Ohio River Basin, 1980, 1990, 2000, 2020, 2040 / Prepared for the U.S. Army Corps of Engineers, Huntington District ... by Robert R. Nathan Associates, Inc., December 1980.
Cincinnati, Ohio : U.S. Army Corps of Engineers, Ohio River Division, 1980.
17 v. : ill. ; 28 cm.
Contract DACW69-78-0136.
"...one of three independent but complementary studies of future freight traffic on the Ohio River Basin Navigation System."

CONTENTS: v.1. Study summary.--v.2. Methodology.--v.3. Commodity groups .

1. Shipping--Ohio River Basin. 2. Inland water transportation--Ohio River Basin--Statistics. 3. Ohio River Basin. I. United States. Army. Corps of Engineers. Ohio River Division. II. United States. Army. Corps of Engineers. Huntington District. III. Title.

HE597.03N3 OCLC no. 7030444

PREFACE

This Corps of Engineers report describes one of three independent but complementary studies of future freight traffic on the Ohio River basin navigation system. Each of the studies considers existing waterborne commerce and develops a consistent set of projections of future traffic demands for all of the navigable waterways of the basin. Each report contains information on past and present waterborne commerce in the basin with projections by commodity group and origin-destination areas from 1976 to either 1990 or 2040.

The three projections, in conjunction with other analytical tools and waterway system information, will be used to evaluate specific waterway improvements required to meet short and long-term navigation needs. The output from these studies will serve as input to Corps inland navigation simulation models to help analyze the performance and requirements for improvements of the Ohio River basin navigation system. These data will be used in current studies relating to improvements of Gallipolis Locks, the Monongahela River, the Upper Ohio River, the Kanawha River, the Lower Ohio River, and the Tennessee River, as well as for other improvements.

The reports on the three studies are referred to as the "CONSAD," the "BATTELLE," and the "NATHAN" reports. The latter and final report was completed in November 1980. It was prepared for the Corps of Engineers by Robert R. Nathan Associates, Inc., Consulting Economists, Washington D.C. This study encompasses the period 1976-2040, and is by far the most detailed of the three.

The "CONSAD" report, completed in January 1979, was prepared for the Corps by the CONSAD Research Corporation of Pittsburgh, Pennsylvania. The study and the 1976-1990 projected traffic demands discussed in that report were developed by correlating the historic waterborne commodity flows on the Ohio River navigation system, with various indicators of regional and national demands for the commodities. The demand variables which appeared to best describe the historic traffic pattern for each of the commodity groups was selected for projection purposes. The projected values for the demand variables are based upon the 1972 OBERS Series E Projections of National and Regional Economic Activity. The OBERS projections serve as national standards and were developed by the Bureau of Economic Analysis of the U.S. Department of Commerce, in conjunction with the Economic Research Service of the Department of Agriculture.

The "BATTELLE" report was completed in June 1979, and was prepared for the Corps by the Battelle Columbus Laboratories, Columbus, Ohio. The study and the 1976-1990 traffic projections discussed in that report were developed by surveying all waterway users in the Ohio River Basin through a combined mail survey and personal interview approach. The purpose of the survey was to obtain an estimate from each individual shipper of his future commodity

movements, by specific origins and destinations, as well as other associated traffic information. All identifiable waterway users were contacted and requested to provide the survey information. In addition, personal interviews were held with the major shippers. The responses were then aggregated to yield projected traffic demands for the Ohio River navigation system.

The "NATHAN" report presents the findings of a commodity resource inventory, a modal split analysis and a market demand analysis. The work included investigation and analyses of the production, transportation, and demand characteristics of each of the major commodities transported on the Ohio River and its tributaries. For each of 15 commodity groups, the demand for waterway transportation into, out of, and within the Ohio River basin was projected through the year 2040. A detailed study analysis and discussion for each commodity group is presented in 15 individually bound reports, supplemented by a methodology report. A Study Summary and an Executive Summary present appropriately abbreviated discussion and findings resulting from these analyses. The Study Summary aggregates the commodity group totals for each of the several projection periods and lists the total waterborne commerce for each of the 72 operational locks and dams in the Ohio River Basin.

The "NATHAN" report, "Projections of Demand for Waterborne Transportation, Ohio River Basin, 1980, 1990, 2000, 2020, 2040" consists of the following volumes:

Subject Title	Number of Pages	Volume Number
Study Summary	220	1
Methodology	118	2
Group I: Coal and Coke	134	3
Group II: Petroleum Fuels	66	4
Group III: Crude Petroleum	42	5
Group IV: Aggregates	64	6
Group V: Grains	131	7
Group VI: Chemicals and Chemical Fertilizers	90	8
Group VII: Ores and Minerals	61	9
Group VIII: Iron Ore, Steel and Iron	104	10
Group IX: Feed and Food Products, Nec.	44	11
Group X: Wood and Paper Products	61	12
Group XI: Petroleum Products, Nec.	38	13
Group XII: Rubber, Plastic, Nonmetallic Mineral Products, Nec.	41	14
Group XIII: Nonferrous Metals and Alloys, Nec.	57	15
Group XIV: Manufactured Products Nec.	35	16
Group XV: Others, Nec.	48	17

Additionally, an Executive Summary is available as a separate document.

RRNA

PROJECTIONS OF DEMAND FOR WATERBORNE TRANSPORTATION
OHIO RIVER BASIN
1980, 1990, 2000, 2020, 2040

Group XI: Petroleum Products, Nec.

Prepared for
U.S. Army Corps of Engineers
Huntington District
Contract No. DACW69-78-C-0136

by
Robert R. Nathan Associates, Inc.
Consulting Economists
Washington, D.C.

November 1980

TABLE OF CONTENTS

		Page
I.	INTRODUCTION	1
	A. Description of Group XI	1
	B. Existing Waterway Traffic Flows	2
	B-1. BEA-to-BEA Traffic Flows	2
	B-2. Highlights of Important Links	2
	C. Summary of Study Findings	5
II.	MARKET DEMAND ANALYSIS	7
	A. Market Areas	7
	A-1. Primary Study Areas (PSAs)	7
	A-2. Secondary Consumption Areas (SCAs)	7
	B. Product Uses	8
	B-1. Lubricating Oils and Greases	8
	B-2. Naphthas	8
	B-3. Asphalts, Tar and Pitches	8
	C. Consumption Characteristics	9
	D. Existing Aggregate Demands	9
	E. Forecasting Procedures and Assumptions	9
	F. Probable Future Demand	11
III.	COMMODITY RESOURCE INVENTORY	13
	A. Production Areas	13
	B. Production Characteristics	13
	C. Existing Production Levels	13
	D. Forecasting Procedures and Assumptions	15
	E. Probable Future Supply	15
IV.	TRANSPORTATION CHARACTERISTICS	19
	A. Existing and Historical Modal Split	19
	B. Factors Affecting Modal Choice	19
	C. Forecasting Procedures and Assumptions and Probable Future Modal Split	21
	D. Probable Future Waterway Traffic Flows	22
V.	APPENDIX	27
VI.	SOURCES AND REFERENCES	35

I. INTRODUCTION

Group XI, petroleum products, nec., consists of relatively low gravity petroleum products which are not suitable for pipeline transportation. In 1976, this group accounted for 1.4 percent of the total waterborne commerce in the Ohio River System (ORS).

The areas within the Ohio River Basin (ORB) for which projections of Group XI consumption, production and movements have been made are designated as Primary Study Areas (PSAs). The PSAs for Group XI are those U.S. Department of Commerce Bureau of Economic Analysis Areas (BEAs) and area segments (aggregations of counties within a BEA) which are origins or destinations of Group XI waterborne movements. A map showing Group XI PSAs is presented in the appendix to this report.

In addition to PSAs, external areas which are linked to the ORB through waterborne commerce have been identified. Areas (BEAs) outside the ORB which are destinations of waterborne petroleum products, nec., movements originating in the ORB are designated as Secondary Consumption Areas (SCAs). Areas (BEAs) outside the ORB which are origins of Group XI waterborne movements destined to the ORB are designated as Secondary Production Areas (SPAs).

A. Description of Group XI

The individual products included in Group XI are:

Waterborne Commerce Statistics Code (WCSC)	Product/Commodity
2916	Lubricating oils and greases

2917	Naphtha, mineral spirit, solvent, etc.
2918	Asphalt, tar and pitches.

The uses and characteristics of production and consumption of individual products have been considered separately. However, all commodities have been combined for projection purposes in this study.

B. Existing Waterway Traffic Flows

The total inbound, outbound and local waterborne shipments of petroleum products in the ORS amounted to 2.7 million tons in 1969, reached a peak of 2.8 million tons in 1974 and decreased to 2.8 million tons in 1976. As a percentage of total ORS traffic, Group XI accounted for 1.7 percent in 1969 and 1.4 percent in 1976. Outbound and local movements together equalled one-quarter of the inbound tonnage (Table 1).

B-1. BEA-to-BEA Traffic Flows

Most waterside BEAs in the Ohio River Basin, except for BEA 53 (Lexington), 46 (Memphis) and 55 (Evansville), reported some shipments or receipts of petroleum products in the 1969-76 period. In 1976, BEA 66 (Pittsburgh) reported the largest amount of waterborne receipts (867.4 thousand tons), of which 188.2 thousand tons originated in BEA 52 (Huntington). BEA 52, which recorded the largest outbound shipment (388.4 thousand tons), also relied on the waterway for the receipt of some petroleum products. BEAs 48 (Chattanooga), 49 (Nashville), 50 (Knoxville) and 68 (Cleveland) received petroleum products via the waterway and recorded no outbound shipments (Table 2).

B-2. Highlights of Important Links

In 1976, there were seven BEAs in the ORB reporting some outbound shipment of petroleum products. BEA 52 (Huntington) recorded the largest shipment, 400.4 thousand tons,[1] to Ohio River Basin

---

1. Including 12.0 thousand tons of local (intra-BEA) movement.

BEST DOCUMENT AVAILABLE

Table 1. Ohio River System: Waterborne Shipments of Petroleum Products by Commodity Inbound, Outbound, and Local Movements, 1969-76

(Thousands of tons unless otherwise specified)

Commodity and type of movements	1969	1970	1971	1972	1973	1974	1975	1976	Average annual percentage change, 1969-76
Total	2,698.9	2,539.2	2,589.0	2,506.7	2,614.3	2,803.9	2,614.2	2,793.3	0.5
Inbound	1,743.8	1,797.2	1,842.1	1,819.5	2,061.0	2,206.4	1,955.9	2,016.7	2.1
Outbound	165.0	167.5	90.8	141.4	88.7	110.7	84.7	140.6	(2.3)
Local	790.1	574.5	656.1	545.8	464.6	486.8	573.6	636.0	(3.1)
Lubricating oils, greases	410.2	493.5	450.1	436.0	531.7	572.7	629.1	539.8	4.0
Inbound	395.7	468.5	440.3	432.8	511.0	564.3	534.4	513.4	3.8
Outbound	13.0	22.7	--	--	0.7	--	4.0	9.4	(4.5)
Local	1.5	2.3	9.8	3.2	20.0	8.4	90.8	17.0	41.5
Naphtha, mineral spirits, etc.	420.4	299.8	257.5	315.7	347.5	437.1	327.1	364.0	(2.0)
Inbound	305.0	192.6	184.1	220.1	271.3	325.7	261.1	249.2	(2.8)
Outbound	72.9	63.5	35.5	50.4	39.5	59.1	19.1	52.7	(4.5)
Local	42.5	43.7	37.9	45.2	36.7	52.3	46.9	62.1	5.6
Asphalt, tar, pitches	1,868.4	1,745.9	1,881.3	1,755.1	1,735.0	1,794.1	1,658.0	1,889.6	0.2
Inbound	1,043.1	1,136.1	1,217.7	1,166.6	1,278.8	1,316.4	1,160.5	1,254.2	2.7
Outbound	79.1	81.3	55.2	91.0	48.4	51.6	61.6	78.5	(0.1)
Local	746.2	528.5	608.4	497.5	407.9	426.1	435.9	556.9	(4.1)

Note: Individual items may not add to totals due to rounding.
Source: Compiled by RRNA from Waterborne Commerce by Port Equivalents, 1969-76, supplied by the U.S. Army Corps of Engineers.

BEST DOCUMENT AVAILABLE

Table 2. Ohio River Basin: Waterborne Commerce by BEA, 1976
Group 11: Petroleum Products, Nec.
(Thousands of tons)

Origin	Destination																		
	Total	ORB BEAs	BEA 47	BEA 48	BEA 49	BEA 50	BEA 52	BEA 54	BEA 62	BEA 64	BEA 66	BEA 68	Non-ORB BEAs	BEA 46	BEA 77	BEA 114	BEA 137	BEA 138	BEA 141
Total	2,793.3	2,652.7	33.4	284.5	285.4	111.3	116.2	347.5	365.0	142.5	867.4	99.5	140.6	3.1	6.0	3.3	1.1	90.5	36.6
ORB BEAs	776.6	636.0	--	--	16.0	--	42.3	121.0	59.0	97.0	250.7	50.0	140.6	3.1	6.0	3.3	1.1	90.5	36.6
BEA 47	17.3	11.0	--	--	--	--	3.2	--	--	--	7.8	--	6.3	--	--	--	--	--	6.3
BEA 52	400.4	360.2	--	--	11.0	--	12.0	35.0	55.0	9.0	188.2	50.0	40.2	--	6.0	--	1.1	6.1	27.0
BEA 54	7.0	7.0	--	--	5.0	--	--	2.0	--	--	--	--	--	--	--	--	--	--	--
BEA 62	214.0	214.0	--	--	--	--	--	84.0	--	88.0	42.0	--	--	--	--	--	--	--	--
BEA 64	11.6	11.6	--	--	--	--	--	--	--	--	11.6	--	--	--	--	--	--	--	--
BEA 66	123.0	32.2	--	--	--	--	27.1	--	4.0	--	1.1	--	90.8	3.1	--	--	--	84.4	3.3
BEA 115	3.3	--	--	--	--	--	--	--	--	--	--	--	3.3	--	--	3.3	--	--	--
Non-ORB BEAs	2,016.7	2,016.7	33.4	284.5	269.4	111.3	73.9	226.5	306.0	45.5	616.7	49.5							
BEA 38	5.6	5.6	--	--	--	5.6	--	--	--	--	--	--							
BEA 46	15.6	15.6	--	--	15.6	--	--	--	--	--	--	--							
BEA 77	24.3	24.3	2.2	--	--	--	12.0	1.0	--	--	8.0	1.1							
BEA 91	63.1	63.1	--	6.0	57.1	--	--	--	--	--	--	--	**Traffic external to Ohio River System**						
BEA 114	660.8	660.8	18.0	143.9	100.6	105.7	--	39.0	72.2	15.0	166.4	--							
BEA 137	131.0	131.0	--	40.0	--	--	--	--	91.0	--	--	--							
BEA 138	414.6	414.6	--	12.0	96.1	--	--	135.3	9.0	17.5	131.3	13.4							
BEA 140	326.0	326.0	--	44.5	--	--	8.9	9.7	97.9	--	158.3	6.7							
BEA 141	374.6	374.6	12.1	38.1	--	--	53.0	41.5	35.9	13.0	152.7	28.3							
BEA 144	1.1	1.1	1.1	--	--	--	--	--	--	--	--	--							

Source: U.S. Army Corps of Engineers, Waterborne Commerce by Port Equivalents, revised 1976.

BEAs. Only 40.2 thousand tons were transported to destinations outside the ORB.

BEA 66 (Pittsburgh) reported 867.4 thousand tons of petroleum products receipts via the waterway, twice the amount received by the next major receiver, BEA 62 (Cincinnati) or by BEA 54 (Louisville). Except for 188.2 thousand tons of products shipped to BEA 66 from BEA 52 (Huntington), all major shipments were from BEAs outside the ORB.

C. Summary of Study Findings

A large percentage of the movements of Group XI within the ORB are made by barge. Pipelines cannot be used to transport the products. Truck and rail together account for about one-quarter of the inbound shipments and four-fifths of the outbound shipments. Outbound shipments by barge are mostly to BEA 138 (New Orleans); outbound shipments by truck and rail are to BEAs located north and east of the ORB. Inbound shipments come primarily from BEA 138, BEA 141 (Houston) and BEA 140 (Beaumont), major U.S. petroleum-producing areas. The modal splits (percentage shares of Group XI products moved by the various transport modes) vary between individual BEA pairs. Generally, the choice of mode is dictated by the location of production relative to consumption areas. Modal shifts are not expected in the future unless there are major changes in the distributions of production and consumption among BEAs.

Although a large percentage of petroleum product movements are by barge, the consumption and production of those products are small compared with other commodities. The Group XI share of waterborne movements has been only about 1.5 percent of the total ORS waterborne commerce in the past decade.

Production of petroleum products in the Primary Study Areas is expected to decrease from 1,026.9 thousand tons in 1976 to 945.9 thousand tons in 2040. A peak level of 2,272.2 thousand tons is expected to be reached in 1990. Consumption will follow a similar trend: there will be a slight average increase of 0.13 percent per year for the 1976-2040 period, resulting in an average annual increase of 0.4 percent in gross waterborne movements in the ORS. The inbound waterborne movements are also projected to increase at an average annual rate of 0.4 percent, while outbound shipments will increase at an average annual rate of 0.5 percent.

BLANK PAGE

II. MARKET DEMAND ANALYSIS

Consumption of commodities in Group XI in the Primary Study Areas increased slightly during the period 1969-76 from 2,724.2 thousand tons to 2,833.7 thousand tons. However, within this time frame, the level of ORB consumption fluctuated considerably, ranging from 3,231.7 thousand tons in 1973 to 2,671.0 thousand tons in 1975. This pattern reflects national consumption behavior. During the period 1976-2000, consumption is projected to grow at an average annual rate of 2.6 percent. After the year 2000, ORB consumption is expected to decline.

A. Market Areas

In addition to local demand for Group XI commodities produced in the PSAs, demand also is generated by Secondary Consumption Areas (SCAs) located outside the ORB. These SCAs are defined as BEAs which are the destinations of waterborne petroleum products, nec., movements originating in the Ohio River Basin.

A-1. Primary Study Areas (PSAs)

This study has identified 11 BEAs and BEA segments in the ORB which either have been or will be ultimate origins or destinations of waterborne movements of Group XI commodities. Appendix Table A-1 presents the BEAs and BEA segments which constitute the PSAs for petroleum products, nec., and for which consumption of Group XI products has been analyzed and projected.

A-2. Secondary Consumption Areas (SCAs)

BEAs outside the Ohio River Basin which are destinations of waterborne shipments from the ORB were not segmented, nor was any

attempt made to analyze or project consumption in these BEAs. Such efforts were not warranted due to low volume of both historical and projected shipments from the ORB to Secondary Consumption Areas.[1]

B. Product Uses

Petroleum products have a variety of uses most of which are in the industrial and transportation sectors.

B-1. Lubricating Oils and Greases

Lubricating oils include liquid lubricants containing more than 50 percent refined petroleum distillates or specially treated petroleum residuum. Lubricating greases, solid semifluid products, are lubricating oils which contain thickening agents.[2] Lubricating oils and greases serve as lubricants for machinery in the industrial and transportation sectors.

B-2. Naphthas

There are two principal types of naphthas: special naphthas and industrial naphthas, both of which are used as petrochemical feedstocks. Special naphthas are products refined to specific flash points and boiling ranges. They are used as paint thinners, cleaning fluids, solvents, etc. Industrial naphthas are primarily used in the production of ethylene, aromatics and synthetic natural gas (SNG). In 1976, Naphtha-400° accounted for one-half of the total U.S. demand for petrochemical feedstocks.

B-3. Asphalts, Tar and Pitches

Asphalt is a dark-brown to black cementitious material of which the predominant constituents, bitumens, occur in nature or are obtained in petroleum processing. Asphalt and asphaltic products are primarily used in highway construction and maintenance.

---

1. The shipments of Group XI commodities to SCAs were projected based on the projected difference between production and consumption of the commodities in the PSAs and the historical shipment patterns.

2. As defined by Department of Energy, Energy Information Administration, Federal Energy Data System (FEDS), Technical Documentation (Washington, D.C.: GPO, 1978), p. E-6.

C. Consumption Characteristics

Consumption characteristics of petroleum products, nec., are determined by factors influencing their demand. Based on the above discussion of product uses, the total demand for petroleum products is influenced by the importance and growth of the petrochemical industry, by growth in the demand of household use of paints and cleaning agents, and by the technological change and growth in the transportation sector. The regional distribution of household and transportation demands for petroleum products can be estimated on the basis of the distribution of population. Similar to petroleum fuels, the consumption growth of petroleum products in the long run will likely be restricted by the available supply of crude petroleum (see Petroleum Fuels Report).

D. Existing Aggregate Demands

The demand for Group XI products in the PSAs has followed the national consumption trend of the past decade. In 1969, the total consumption of petroleum products in the PSAs was estimated at 2,724.2 thousand tons. It increased slightly to 2,908.3 thousand tons in 1972, took a sharp jump to 3,231.7 tons in 1973 and stood at 2,883.7 million tons in 1976 (Table 3). Asphalt, tar and pitches accounted for 58.6 percent of the consumption of Group XI products. Lubricant consumption was estimated at 16 percent. Naphthas, including 18 percent for industrial naphthas and 7.4 percent for special naphthas, accounted for the remaining 25.4 percent.

The most significant consumption areas for petroleum products are BEA 62 (Cincinnati) and BEA 66 (Pittsburgh). Each of these BEAs consumed nearly 620 thousand tons in 1976. Together they accounted for 43 percent of the total PSA consumption of petroleum products, nec. Large populations and industrial bases are the main reasons for this large percentage share of consumption.

E. Forecasting Procedures And Assumptions

Petroleum products, nec., are residual products obtained in the refining process for petroleum fuels. The values of these commodities are not significant either in dollar terms or in energy production. The output of petroleum products is difficult to forecast since the level of output depends largely on a combination of various types of processed crude oil and technological developments. For this reason, there are no known existing projections of

BEST DOCUMENT AVAILABLE

Table 3. United States and Ohio River Basin: Consumption of Petroleum Products, Nec., by BEAs and BEA Segments, Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
United States	48,872.0	50,929.3	50,695.6	52,608.0	56,741.3	53,519.6	47,007.7	50,318.0
Primary Study Areas	2,724.2	2,784.5	2,751.9	2,908.3	3,231.7	2,827.3	2,671.0	2,883.7
BEA 47: Huntsville, AL	165.2	165.6	162.4	175.9	193.7	165.2	149.1	159.6
BEA 48: Chattanooga, TN	158.0	161.5	156.0	170.4	198.5	164.3	161.7	166.8
BEA 49: Nashville, TN	344.5	343.1	327.7	350.6	420.5	330.4	338.5	345.1
BEA 50: Knoxville, TN	163.9	162.7	155.4	167.5	200.9	156.9	163.5	165.9
BEA 52: Huntington, W.V.	203.3	217.8	223.9	235.7	244.9	217.7	218.2	240.4
BEA 54: Louisville, KY	320.9	335.4	343.9	335.0	385.5	319.7	291.3	300.3
BEA 62: Cincinnati, OH	588.9	592.1	579.1	604.8	678.9	615.5	567.2	617.3
BEA 64: Columbus, OH	72.1	84.7	92.5	107.8	124.8	127.5	126.5	159.2
BEA 66: Pittsburgh, PA	602.0	614.7	606.1	651.7	661.7	624.2	552.9	619.8
BEA 68: Cleveland, OH	42.1	43.2	42.5	45.7	50.6	45.0	43.3	44.6
BEA 115: Paducah, KY	63.3	63.7	62.4	63.4	71.7	60.9	58.8	65.7

Note: Consumption of lubricants, asphalt and road oil, and special naphthas by BEA segments based on population and per capita consumption. Consumption of industrial naphthas were distributed among BEA segments on the basis of chemical and allied products employment.

Source: U.S. and State Consumption from U.S. Department of Interior, Bureau of Mines, Mineral Yearbook, 1970-76 and U.S. Department of Energy, Federal Energy Data System (FEDS), Technical Documentation, June 1978; Chemical and allied products employment data was from the U.S. Department of Commerce, Bureau of the Census, County Business Patterns, 1970-76; population data provided by the U.S. Department of Commerce Bureau of Economic Analysis.

either the consumption or production of petroleum products, nec. The Oak Ridge National Laboratory (ORNL), in a report published in June 1978, developed projections for 1980 and 1985 of energy supply and demand patterns for the United States, each of the nine census regions, 50 states and 173 BEAs.[1] The projections were made for seven fuel types, including crude oil, distillate oil, residual oil, gasoline, other hydrocarbons, natural gas and coal.[2] In the absence of official projections, the ORNL's projections of "other hydrocarbons" consumption provides the most suitable means of projecting the consumption of petroleum products, nec.

The application of 1974-80 average annual growth rates (based on ORNL estimated "other hydrocarbons" consumption by BEA) to historical consumption of petroleum products, nec., yields 1980 projections for the PSAs. Projections for 1990 can be made by following the same procedures, extending the 1980-85 BEA annual growth rates provided in the Oak Ridge report to cover the 1980-90 period. Beyond the year 1990, consumption is assumed to increase at the same rate as the consumption of petroleum fuels in the PSAs. Table 4 provides additional information on projection procedures.

In sum, the basic implicit assumptions in the projection procedures are that the consumption of petroleum products, nec., by the PSAs, will grow at the same rate as the BEAs as a whole, and that the consumption growth of "other hydrocarbons" equals the consumption growth of petroleum products, nec., for each BEA.

F. Probable Future Demand

The consumption of petroleum products, nec., in the PSAs is projected to increase rapidly to the year 2000. It is then expected to decrease at an accelerating rate due to diminished supplies in the next century. Consumption in BEAs 66 (Pittsburgh) and 62 (Cincinnati) are projected to remain significant throughout the projection period. From 1976 to 2040, while most BEAs are projected to experience negative average annual rates of consumption growth, seven BEA segments will show a slight increase (Table 4).

---

1. Oak Ridge National Laboratory, Energy Availabilities for State and Local Development: Projected Energy Patterns for 1980 and 1985 (Oak Ridge, TN: ORNL, 1978).

2. "Other hydrocarbons" includes all petroleum fuels and products except gasoline, distillate oil and residual oil. See Petroleum Fuels Report for more detailed discussions of the ORNL report.

BEST DOCUMENT AVAILABLE

Table 4. Ohio River Basin: Consumption of Petroleum Products, Nec., by BEAs or BEA Segments,[a] Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected 1980	1990	2000	2020	2040	Average annual percentage change 1976-90	1976-2040
Primary Study Areas	2,883.7	3,326.2	4,882.1	5,308.6	4,442.1	3,126.8	3.83	0.13
BEA 47: Huntsville, AL	158.6	162.7	251.2	273.3	228.7	161.0	3.34	0.02
BEA 48: Chattanooga, TN	166.8	161.8	246.0	267.4	223.7	157.5	2.81	(0.09)
BEA 49: Nashville, TN	345.1	381.4	604.9	657.6	550.3	387.3	4.09	0.18
BEA 50: Knoxville, TN	165.9	243.7	352.8	383.6	321.0	226.0	5.54	0.48
BEA 52: Huntington, WV	240.4	238.0	326.7	355.5	297.5	209.4	2.22	(0.22)
BEA 54: Louisville, KY	300.3	277.7	426.3	463.4	387.7	272.9	2.53	(0.15)
BEA 62: Cincinnati, OH	617.3	739.2	1,110.1	1,207.3	1,010.2	711.1	4.28	0.22
BEA 64: Columbus, OH	159.2	163.9	246.6	267.9	224.2	157.8	3.18	(0.01)
BEA 66: Pittsburgh, PA	619.8	855.2	1,171.8	1,274.4	1,066.4	750.6	4.65	0.30
BEA 68: Cleveland, OH	44.6	44.5	61.9	67.1	56.2	39.5	2.37	(0.19)
BEA 115: Paducah, KY	65.7	58.1	83.8	91.1	76.2	53.7	1.75	(0.31)

Note: The 1980 projections were estimated by computing the average annual growth rates of consumption of "other hydrocarbons" for the 1974-80 period for each BEA in the Oak Ridge Report and by assuming that the growth rates of BEA segments consumption are the same as those of the whole BEAs. Estimates for 1990 were derived by the same methods, extending the 1980-85 average annual growth rates of the BEAs to cover the 1980-90 period. For the post 1990 years, the consumption of petroleum products for the ORB as a region is assumed to grow at the same rate as the consumption of petroleum fuels. Allocation of ORB consumption to BEA segments is based on the 1985 distribution ratios.

a. Segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: U.S. Department of Energy, Energy Information Administration, Annual Report to Congress, Vol. II, 1977 ed.; Oak Ridge National Laboratory, Energy Availabilities for State and Local Development: Projected Energy Patterns for 1980 and 1985, June 1978; and Petroleum Fuels (Group II) Report.

III. COMMODITY RESOURCE INVENTORY

Production of petroleum products, nec., in the PSAs remained stable during the period 1969-76, with annual production levels ranging from 980.9 thousand tons to 1,102.2 thousand tons. Production is projected to increase through the year 1990 and to decrease thereafter.

A. Production Areas

The production of Group XI commodities in the PSAs is supplemented by production in Secondary Production Areas (SPAs) located outside the Ohio River Basin. These SPAs are defined as BEAs which are the origins of Group XI waterborne movements destined to the Ohio River Basin.

B. Production Characteristics

Production characteristics of petroleum products are determined by factors influencing commodity supply. In recent years, newly developed technology has enabled refineries to increase fuel production and decrease petroleum products production per barrel of crude oil which is refined. On the other hand, the increased use of heavy and high-sulfur crude oils, such as Alaskan North Slope crude, is expected to yield a larger volume of petroleum products. In the long run, it is likely that the most significant factors influencing the production of petroleum products will be the availability of crude oil. Crude oil supply, both domestic and imported, is expected to decrease by the turn of the century (see Group III, Crude Petroleum Report).

C. Existing Production Levels

From 1969 to 1976, the U.S. production of petroleum products, nec., increased from 46 million tons to 50 million tons (Table 5).

BEST DOCUMENT AVAILABLE

Table 5. United States and Ohio River Basin: Production of Petroleum Products, Nec., by BEAs or BEA Segments[a], Estimated 1969-76

(Thousands of tons)

BEA and BEA segment	1969	1970	1971	1972	1973	1974	1975	1976
United States	46,079.2	48,048.4	49,555.4	50,118.0	53,047.2	53,471.7	45,697.4	49,870.2
Primary Study Areas	980.9	984.9	1,050.7	1,028.1	1,092.1	1,102.2	988.8	1,026.9
BEA 47: Huntsville, AL	--	--	--	--	--	--	--	--
BEA 48: Chattanooga, TN	--	--	--	--	--	--	--	--
BEA 49: Nashville, TN	--	--	--	--	--	--	--	--
BEA 50: Knoxville, TN	--	--	--	--	--	--	--	--
BEA 52: Huntington, WV	555.6	565.3	607.6	587.9	622.5	627.4	558.3	576.3
BEA 54: Louisville, KY	90.3	92.1	99.5	96.6	101.8	102.0	90.1	92.3
BEA 62: Cincinnati, OH	162.7	163.6	173.7	170.8	180.3	180.2	158.1	164.5
BEA 64: Columbus, OH	79.1	72.1	71.9	72.8	78.6	81.2	76.5	81.2
BEA 66: Pittsburgh, PA	93.2	91.8	98.0	100.0	108.9	111.4	105.8	112.6
BEA 68: Cleveland, OH	--	--	--	--	--	--	--	--
BEA 115: Paducah, KY	--	--	--	--	--	--	--	--

Note: Petroleum products include lubricating oils and greases, naphthas, and asphalt. Production of naphthas by BEA segments based on the ratio of naphtha production to gasoline production and the production of gasoline by BEA segments. Production of gasoline by BEA segments based on state motor gasoline figures distributed among BEA segments on the basis of the 1969-76 distribution of state gasoline capacity of operating plants among BEA segments. Annual distribution was estimated as the average of distributions obtained for January 1 of each year and the following year. 1969 distribution of capacity assumed equal to January 1, 1970 distribution. Production of asphalt by BEA segments based on the ratio of Petroleum Administration for Defense district asphalt production to district asphalt capacity multiplied by asphalt capacity by BEA segments. This capacity was estimated from the crude petroleum operating capacity for refineries producing asphalt locating in each BEA. Distribution of capacity assumed equal to 1972 distribution. Lubricant production was estimated using the same procedure.

a. Segments defined as counties which are ultimate origins or destinations of waterborne movements.

Source: U.S. Department of Interior, Bureau of Mines, "Crude Petroleum and Petroleum Products," Minerals Yearbook, 1969-76 eds., and Mineral Industry Surveys: Petroleum Refineries in the United States and Puerto Rico, January 1, 1970-76 eds.

This growth, however, was not steady. In fact, the production level reached 53.5 million tons in 1974 and dropped to 45.7 million tons in 1975. From 1975 to 1976, the production of lubricants increased 10.8 percent and naphtha production increased 9.5 percent. Asphalt production, unchanged after registering an 11.4 percent increase, declined from 1975 to 1976 due to reductions in highway construction and maintenance. Overall, the production of Group XI products followed the general business cycle of economic activity.

In the PSAs, petroleum products production was estimated at 980.9 thousand tons in 1969. It increased to 1,102.2 thousand tons in 1974 and declined to 1,026.9 thousand tons in 1976. Production changes in the PSAs were consistent with national production levels.

BEA 52 (Huntington) is the major producing area. In 1976, this BEA accounted for 57 percent of total production in the PSAs. The remaining 44 percent was produced in BEAs 62 (Cincinnati), 66 (Pittsburgh), 54 (Louisville) and 64 (Columbus).

D. Forecasting Procedures and Assumptions

As discussed above, in the long run the most significant factor affecting the production of petroleum products, nec., is the consumption of crude oil. Generally, projections of BEA production of petroleum products are based on the growth rates of crude oil consumed by BEAs.[1] Discussions with industrial authorities reveal that petroleum products production in BEA 52 (Huntington) will deviate substantially from its historical pattern. As a result, that BEA's production projection has been based solely on interviews. By 1980, BEA 52 production is expected to increase 64 percent above the 1976 level. Since BEA 52 is already the largest producing BEA, the effects of such a rapid growth will be reflected in the production growth rate of the PSAs as a whole.

E. Probable Future Supply

The production of Group XI products in the PSAs is projected to increase from 1.0 million tons in 1976 to 1.9 million tons in 1980 and to nearly 2.3 million tons in 1990 (Table 6). Beginning in the mid-1990s, the PSAs will likely experience negative growth. The actual production levels of petroleum products will decrease to

---

1. Such growth rates are discussed in the Crude Petroleum (Group III) Report of this study.

BEST DOCUMENT AVAILABLE

Table 6. Ohio River Basin: Production of Petroleum Products, Nec., by BEAs or BEA Segments[a], Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

BEA and BEA segment	Estimated 1976	Projected					Average annual percentage change	
		1980	1990	2000	2020	2040	1976-90	1976-2040
Primary Study Areas	1,026.9	1,918.7	2,272.2	2,124.5	1,625.3	945.9	5.84	(0.13)
BEA 47: Huntsville, AL	--	--	--	--	--	--	--	--
BEA 48: Chattanooga, TN	--	--	--	--	--	--	--	--
BEA 49: Nashville, TN	--	--	--	--	--	--	--	--
BEA 50: Knoxville, TN	--	--	--	--	--	--	--	--
BEA 52: Huntington, WV	576.3	1,260.8	1,717.6	1,605.9	1,228.5	714.9	8.11	0.34
BEA 54: Louisville, KY	92.3	108.1	154.3	144.3	110.4	64.3	3.74	(0.56)
BEA 62: Cincinnati, OH	164.5	183.8	262.8	245.7	188.0	109.4	3.40	(0.64)
BEA 64: Columbus, OH	81.2	168.0	57.5	53.8	41.2	24.0	(2.44)	(1.89)
BEA 66: Pittsburgh, PA	112.6	198.0	80.0	74.8	57.2	33.3	(2.41)	(1.89)
BEA 68: Cleveland, OH	--	--	--	--	--	--	--	--
BEA 115: Paducah, KY	--	--	--	--	--	--	--	--

Note: Projections of all BEAs except BEA 52 were derived by applying the growth rates of petroleum fuels (Group II) production to the 1976 estimates of petroleum products, nec., production. BEA 52 production estimates for 1980 were based on discussions with industrial authorities in this BEA. Projections for BEA 52 for later decades were made assuming the growth rates of petroleum products production equal those of petroleum fuels.

a. Segments defined as counties which are ultimate origins and destinations of waterborne movements.

Source: Table 5; Petroleum Fuels (Group II) Report, and discussions with industrial authorities.

2.1 million tons by 2000. Following the reduced supply and consumption of crude oil, the production of petroleum products will decrease further. This will result in annual production levels of less than 1.0 million tons by 2040.

BEA 52 (Huntington) is projected to experience the most rapid growth (8.1 percent per annum) for the 1976-90 period. Between 1976 and 2040, however, BEA 52 growth is projected to be only 0.34 percent per annum. BEAs 62 (Cincinnati) and 66 (Pittsburgh) will decline most rapidly, at an average annual rate of 1.9 percent, from 1976 to 2040 (Table 6).

BLANK PAGE

IV. TRANSPORTATION CHARACTERISTICS

There is little data available on the transportation characteristics of petroleum products, nec., either at a national or regional level. The Department of Energy provides some data on movements of certain petroleum products by tanker and barge between petroleum districts.[1] No information on rail or truck movements has been published. In 1976, approximately 31 percent (56 million barrels) of the lubricating oil consumed in the United States was moved by tanker and barge. The ratios were 38.5 percent for special naphthas and 4.3 percent for asphalt and road oil.

A. Existing and Historical Modal Split

In the PSAs, inbound waterborne shipments accounted for 70 percent of total consumption of petroleum products, and rail accounted for about 6 percent of the consumption in 1976. Rail reported net outbound shipments from the PSAs of 88 thousand tons, while the waterways showed almost 1.9 million tons of net inbound shipments (Table 7). Truck, estimated as the residual, received 68.3 thousand tons of net inbound receipts.

B. Factors Affecting Modal Choice

Petroleum products include mostly low-value-to-weight products which are not easily damaged. The transport mode is mainly chosen on the basis of transport costs which are influenced by the relative locations of consumption markets and production sources.

---

1. The U.S. consists of five Petroleum Administration for Defense (PAD) Districts. For explanations of these districts, see, for example, Bureau of Mines, "Crude Petroleum and Petroleum Products," Minerals Yearbook, 1976 ed., (Washington, D.C.: GPO, 1979).

BEST DOCUMENT AVAILABLE

Table 7. Ohio River Basin: Production, Consumption and Shipments by Mode of Transportation Of Petroleum Products, Nec., by BEAs and BEA Segments[a], Estimated 1976

(Thousands of tons)

BEA and BEA segment	Production	Consumption	Total net	Shipments (receipts)								Net truck
				Water				Rail				
				Net	Inbound	Outbound	Local	Net	Inbound	Outbound	Local	
Primary Study Areas	1,026.9	2,883.7	(1,856.8)	(1,876.1)	2,016.7	140.6	636.0	87.6	161.4	249.0	62.1	(68.3)
BEA 47: Huntsville, AL	--	158.6	(158.6)	(16.1)	33.4	17.3	--	5.6	3.0	8.6	--	(148.1)
BEA 48: Chattanooga, TN	--	166.8	(166.8)	(284.5)	284.5	--	--	(11.9)	11.9	--	--	129.6
BEA 49: Nashville, TN	--	345.1	(345.1)	(285.4)	285.4	--	--	(26.5)	26.5	--	--	(33.2)
BEA 50: Knoxville, TN	--	165.9	(165.9)	(111.3)	111.3	--	--	(12.2)	12.2	--	--	(42.4)
BEA 52: Huntington, WV	576.3	240.4	335.9	284.2	104.2	388.4	12.0	67.0	19.9	86.9	4.5	(15.3)
BEA 54: Louisville, KY	92.3	300.3	(208.0)	(340.5)	345.5	5.0	2.0	(30.5)	30.5	--	--	163.0
BEA 62: Cincinnati, OH	164.5	617.3	(452.8)	(151.0)	365.0	214.0	--	(37.9)	42.4	4.5	--	(263.9)
BEA 64: Columbus, OH	81.2	159.2	(78.0)	(130.9)	142.5	11.6	--	44.5	--	44.5	--	8.4
BEA 66: Pittsburgh, PA	112.6	619.8	(507.2)	(744.4)	866.3	121.9	1.1	89.5	64.0	153.5	8.7	147.7
BEA 68: Cleveland, OH	--	44.6	(44.6)	(99.5)	99.5	--	--	--	--	--	--	54.9
BEA 115: Paducah, KY	--	65.7	(65.7)	3.3	--	3.3	--	--	--	--	--	(69.0)

Note: Gross and net waterborne and rail shipments (receipts) were determined for 1976 from U.S. Corps of Engineers waterborne commerce data and Interstate Commerce Commission railroad waybill data. Total net shipments (receipts) were determined by subtracting consumption from production. Net truck shipments (receipts) were determined by subtracting net waterborne and rail shipments (receipts) from total net shipments (receipts).

a. Segments defined as counties which are ultimate origins or destinations of waterborne movements.

b. Primary Study Areas shipments equal inbound, outbound and local shipments for the areas as a unit and do not equal the sum of shipments reported for each of the BEA segments.

Source: Production and consumption from Tables 3 and 5. Water and rail shipments compiled by RRNA from Waterborne Commerce by Port Equivalents, 1976, and ICC Railroad Waybill Sample, 1976, supplied by the U.S. Army Corps of Engineers.

Barge rates average about one-half of rail rates and one-eighth of truck rates. Thus, when there is a convenient waterway between the consumption and production locations, barges are usually a preferred mode of transport. Low transport cost is the main reason for all PSAs receiving petroleum products by barge in 1976. It is also an explanation for the waterway movements of a large percentage of petroleum products consumed in the PSAs.

Rail movements occur mostly in long-distance hauls between locations which are not conveniently served by a waterway. For short-distance movements of 100 miles or less, truck is considerably superior to rail. Trucks deliver small orders directly to the distributors of petroleum products on short notice, thus eliminating transshipment costs. In 1976, the largest truck movements were made from the major petroleum products producing areas: BEA 52 (Huntington) and BEA 66 (Pittsburgh).

C. Forecasting Procedures and Assumptions and Probable Future Modal Split

The future waterborne movements of petroleum products were estimated on the basis of projected demand for transportation, historical mode and projected future changes in modal choice. Initial projections of waterborne commerce were developed using preliminary information provided by the Corps of Engineers. These initial projections were based on the 1976 modal split by BEA and BEA segment. It was assumed that relative costs of transport modes will remain constant. Based on the conjecture that the relative transport time will not change significantly in the future, it is expected that the future modal choice will generally conform to the modal split and links which occurred in 1976 (Table 7).

There are five cases which deviate from the general assumptions stated above. Four of these cases involve new barge links. For instance, BEA 64 (Columbus) is projected to experience rapidly decreasing production of petroleum products coupled with steadily rising consumption. Thus, the BEA will require increased future shipments of products from SPAs. These new shipments are expected to come from BEA 141 (Houston) and from foreign sources via BEA 138 (New Orleans).

These projections of waterborne shipments and receipts were distributed among BEA-to-BEA links using historical distribution of shipments among BEA receivers, adjusted for projected changes in BEA shipments and receipts and specific knowledge acquired by commodity specialists during the course of this study.

As more complete information was made available by the Corps of Engineers, the initial projections of BEA-to-BEA waterborne traffic were adjusted.[1]

D. Probable Future Waterway Traffic Flows

Total inbound, outbound and local shipments are projected to increase from 2.8 million tons in 1976 to 6.0 million tons in the year 2000 (Table 8). In the following decades, because of decreasing production and consumption of petroleum products (due to the shortage of crude oil), gross waterborne shipments are projected to decrease rapidly to 3.5 million tons in 2040.

Because of a large expansion in production capacity in BEA 52, outbound and local waterborne movements are expected to increase rapidly in the 1976-90 period. During the 1976-2040 period, inbound movements are projected to increase at an average annual rate of 0.4 percent; outbound movements, at an average annual rate of 0.5 percent; and local shipments, at 0.3 percent. In the future, petroleum products are expected to continue to be relatively insignificant commodities in terms of total waterborne traffic in the ORS.

BEA-to-BEA waterborne traffic projections are presented in Table 9. Growth indices derived from the traffic projections are presented in Table 10.

---

1. A description of the manner in which the initial projections were adjusted is contained in the Methodology Report.

BEST DOCUMENT AVAILABLE

Table 8. Ohio River Basin: Production, Consumption and Shipments by Mode of Transportation of Petroleum Products, Nec., Estimated 1976 and Projected 1980-2040, Selected Years

(Thousands of tons unless otherwise specified)

	Estimated 1976	Projected					Average annual percentage change	
		1980	1990	2000	2020	2040	1976-2000	2000-2040
Production	1,026.9	1,918.7	2,272.2	2,124.5	1,625.3	945.9	3.1	(2.0)
Consumption	2,883.7	3,326.2	4,882.1	5,308.6	4,442.1	3,126.8	2.6	(1.3)
Net shipments (receipts)	(1,856.8)	(1,407.5)	(2,609.9)	(3,184.1)	(2,816.8)	(2,180.9)	2.3	(0.9)
Net waterborne	(1,876.1)	(1,843.4)	(3,135.3)	(3,642.0)	(3,154.1)	(2,356.6)	2.8	(1.1)
Net rail	87.6	683.3	825.8	728.0	533.6	281.0	9.2	(2.4)
Net truck	(68.3)	(247.4)	(300.4)	(270.1)	(196.3)	(105.3)	5.9	(2.3)
Gross waterborne shipments:								
Outbound	140.6	201.5	318.1	335.1	275.6	188.0	3.7	(1.4)
Inbound	2,016.7	2,044.9	3,453.4	3,977.1	3,429.7	2,544.6	2.9	(1.1)
Local	636.0	1,284.0	1,829.6	1,750.5	1,353.1	786.2	4.3	(2.0)
Total	2,793.3	3,530.4	5,601.1	6,062.7	5,058.4	3,518.8	3.3	(1.4)

Note: Projected net shipments (receipts) determined by subtracting projected consumption from projected production. Initial projections of waterborne shipments and receipts were based on preliminary information provided by the Corps of Engineers. Projected modal split by BEA and BEA segment would remain constant in the future except when data, analyses and conversations with industrial authorities indicated otherwise. Gross waterborne shipments for each BEA (inbound, outbound, local) were projected by assuming that the relationship between gross and net waterborne shipments in 1976 would remain constant in the future except when data, analyses and conversations with industrial authorities indicated otherwise. As more complete information regarding 1976 waterborne traffic was made available, BEA-to-BEA projections were revised, and projected to increase/decrease at the same rates as projected earlier. Net truck and net rail shipments by BEA and BEA segment were assumed to have the same relationship to one another that existed in 1976.

Source: Tables 4, 6 and 7; Waterborne Commerce by Port Equivalents, 1969-76, supplied by the U.S. Army Corps of Engineers.

BEST DOCUMENT AVAILABLE

Table 9. Ohio River System: BEA-to-BEA Waterborne Traffic of Petroleum Products, Nec.,[1] Actual 1976 and Projected 1980-2040,[2] Selected Years

ORIGIN BEA	DESTINATION BEA	COMMODITY GROUP	THOUSANDS OF TONS					
			1976	1980	1990	2000	2020	2040
038	050	11	56	58	98	112	96	71
046	049	11	156	173	273	297	249	175
047	052	11	32	38	59	55	42	23
047	066	11	76	63	98	136	126	108
047	141	11	63	65	100	109	91	63
052	049	11	110	279	386	353	266	143
052	052	11	120	953	1163	1054	838	514
052	054	11	350	598	832	825	642	380
052	062	11	550	1635	2125	1986	1506	844
052	064	11	90	0	536	508	392	225
052	066	11	1882	4575	6128	5650	4231	2230
052	068	11	500	0	0	0	0	0
052	077	11	60	183	248	223	167	90
052	137	11	11	16	25	25	21	14
052	138	11	61	186	253	228	169	92
052	141	11	270	386	602	421	305	160
054	049	11	50	34	55	64	58	44
054	054	11	20	30	46	62	55	40
062	054	11	440	1787	2517	2397	1868	1069
062	064	11	680	1872	2637	2512	1936	1120
062	066	11	420	514	785	891	764	537
064	066	11	116	0	281	318	271	198
066	046	11	31	44	67	70	57	39
066	052	11	271	399	545	569	428	237
066	062	11	40	51	80	93	79	58
066	066	11	11	12	21	32	47	62
066	138	11	644	1092	1815	1997	1680	1195
066	141	11	33	43	71	78	66	47
077	047	11	22	24	37	40	34	23
077	052	11	120	131	224	220	171	100
077	054	11	10	5	8	10	9	8
077	066	11	80	64	112	432	520	592
077	068	11	11	11	19	22	19	14
091	048	11	60	58	88	96	74	57
091	049	11	571	631	1002	1089	920	641
114	047	11	180	183	282	305	256	179
114	048	11	1439	1375	2055	2241	1884	1327
114	049	11	1006	748	1287	1527	1319	1024
114	050	11	1057	1534	2213	2405	2013	1417
114	054	11	390	195	319	397	397	303
114	062	11	722	723	1180	1474	1321	1040
114	064	11	150	156	262	300	237	189
114	066	11	1664	1612	3435	3974	3418	2526
115	114	11	33	0	0	0	0	0
137	048	11	400	408	772	837	700	492
137	062	11	910	915	1482	1744	1517	1144
138	048	11	120	114	155	164	138	96
138	049	11	961	832	1426	1661	1440	1079
138	054	11	1355	875	1515	1896	1706	1371
138	062	11	90	91	145	168	148	111
138	064	11	175	0	181	219	190	147
138	066	11	1313	2226	3558	3905	3261	2273
138	068	11	134	139	234	268	230	169
140	048	11	445	435	601	651	543	383
140	052	11	89	317	409	421	323	103
140	054	11	97	55	99	129	117	95
140	062	11	979	997	1617	1965	1739	1337
140	066	11	1583	1521	2922	3337	2884	2238
140	068	11	67	70	117	136	115	84
141	047	11	121	125	193	212	179	125
141	048	11	381	367	504	552	456	317
141	052	11	530	996	1404	1355	1047	606
141	054	11	415	237	413	526	474	388
141	062	11	359	362	586	706	622	478
141	064	11	130	0	397	479	423	325
141	066	11	1527	1377	2394	2917	2591	2029
141	068	11	283	294	495	565	495	357
144	047	11	11	11	18	19	15	11
		TOTAL	27933	35304	54011	60627	50584	35188

Source: Robert R. Nathan Associates, Inc.

 BEST DOCUMENT AVAILABLE

Table 10. Ohio River System: Growth Rates of Petroleum Products, Nec., Waterborne Commerece, BEA to BEA, Projected 1976-2040, Selected Years

BEA Pair[a]	Group No.	Index Value[b]	Year[c] 1976	1980	1990	2000	2020	2040
038050	11	56	1000	1040	1749	1998	1714	1261
046049	11	156	1000	1107	1750	1907	1593	1121
047052	11	32	1000	1202	1845	1714	1310	726
047066	11	78	1000	812	1261	1739	1609	1362
047141	11	63	1000	1034	1536	1724	1448	1000
052049	11	110	1000	2537	3512	3213	2432	1341
052052	11	120	1000	7938	9688	8791	6984	4328
052054	11	350	1000	1708	2376	2357	1835	1087
052062	11	550	1000	2972	3863	3610	2739	1534
052064	11	90	1000	0	5952	5643	4357	2500
052066	11	1882	1000	2431	3256	3002	2248	1186
052068	11	500	1000	0	0	0	0	0
052077	11	60	1000	3042	4139	3722	2778	1500
052137	11	11	1000	1429	2228	2301	1871	1259
052138	11	61	1000	3052	4144	3732	2773	1505
052141	11	270	1000	1429	2228	2301	1871	1259
054049	11	50	1000	673	1096	1288	1154	885
054054	11	20	1000	1500	2417	3083	2750	2000
062054	11	840	1000	2127	2997	2854	2200	1273
062064	11	880	1000	2127	2997	2854	2200	1273
062066	11	420	1000	1224	1869	2121	1818	1327
064066	11	116	1000	0	2419	2742	2339	1710
066046	11	31	1000	1417	2167	2250	1833	1250
066052	11	271	1000	1472	2012	2101	1581	875
066062	11	40	1000	1263	2000	2316	1974	1447
066066	11	11	1000	1136	1909	2864	4318	5591
066138	11	844	1000	1294	2151	2366	1990	1416
066141	11	33	1000	1290	2161	2355	2000	1419
077047	11	22	1000	1095	1667	1810	1524	1048
077052	11	120	1000	1091	1868	1835	1421	835
077054	11	10	1000	500	800	1000	900	800
077066	11	80	1000	800	1400	5400	6500	7400
077068	11	11	1000	1040	1749	1998	1714	1261
091048	11	60	1000	964	1473	1600	1236	945
091049	11	571	1000	1105	1754	1907	1612	1122
114047	11	180	1000	1017	1564	1696	1420	994
114048	11	1439	1000	958	1428	1557	1309	922
114049	11	1006	1000	744	1279	1518	1311	1018
114050	11	1057	1000	1451	2094	2275	1904	1341
114054	11	390	1000	500	815	1019	1019	778
114062	11	722	1000	1002	1635	2041	1829	1440
114064	11	150	1000	1040	1749	1998	1714	1261
114066	11	1664	1000	969	2067	2388	2054	1518

BEST DOCUMENT AVAILABLE

Table 10 (Continued)

BEA Pair[a]	Group No.	Index[b] Value	Year[c] 1976	1980	1990	2000	2020	2040
115114	11	33	1000	0	0	0	0	0
137048	11	400	1000	1020	1929	2093	1751	1229
137062	11	910	1000	1006	1629	1917	1667	1257
138048	11	120	1000	947	1292	1363	1150	796
138049	11	961	1000	866	1484	1728	1498	1123
138054	11	1353	1000	647	1120	1401	1261	1013
138062	11	90	1000	1011	1611	1869	1625	1236
138064	11	175	1000	0	1036	1249	1038	839
138066	11	1313	1000	1695	2710	2974	2484	1731
138068	11	134	1000	1040	1749	1998	1714	1261
140048	11	445	1000	978	1351	1463	1221	861
140052	11	89	1000	3567	4600	4733	3633	1156
140054	11	97	1000	571	1024	1333	1202	976
140062	11	979	1000	1018	1652	2007	1776	1366
140066	11	1583	1000	961	1846	2108	1822	1414
140068	11	67	1000	1040	1749	1998	1714	1261
141047	11	121	1000	1034	1597	1756	1471	1034
141048	11	381	1000	964	1323	1448	1198	833
141052	11	530	1000	1879	2649	2557	1975	1144
141054	11	415	1000	570	995	1268	1143	936
141062	11	359	1000	1007	1632	1967	1732	1331
141064	11	130	1000	0	3055	3688	3250	2523
141066	11	1527	1000	902	1568	1910	1697	1328
141068	11	283	1000	1040	1749	1998	1714	1261
144047	11	11	1000	1000	1600	1700	1400	1000

a. The first three digits indicate the BEA of origin; the last three digits indicate the BEA of destination.

b. Hundreds of tons.

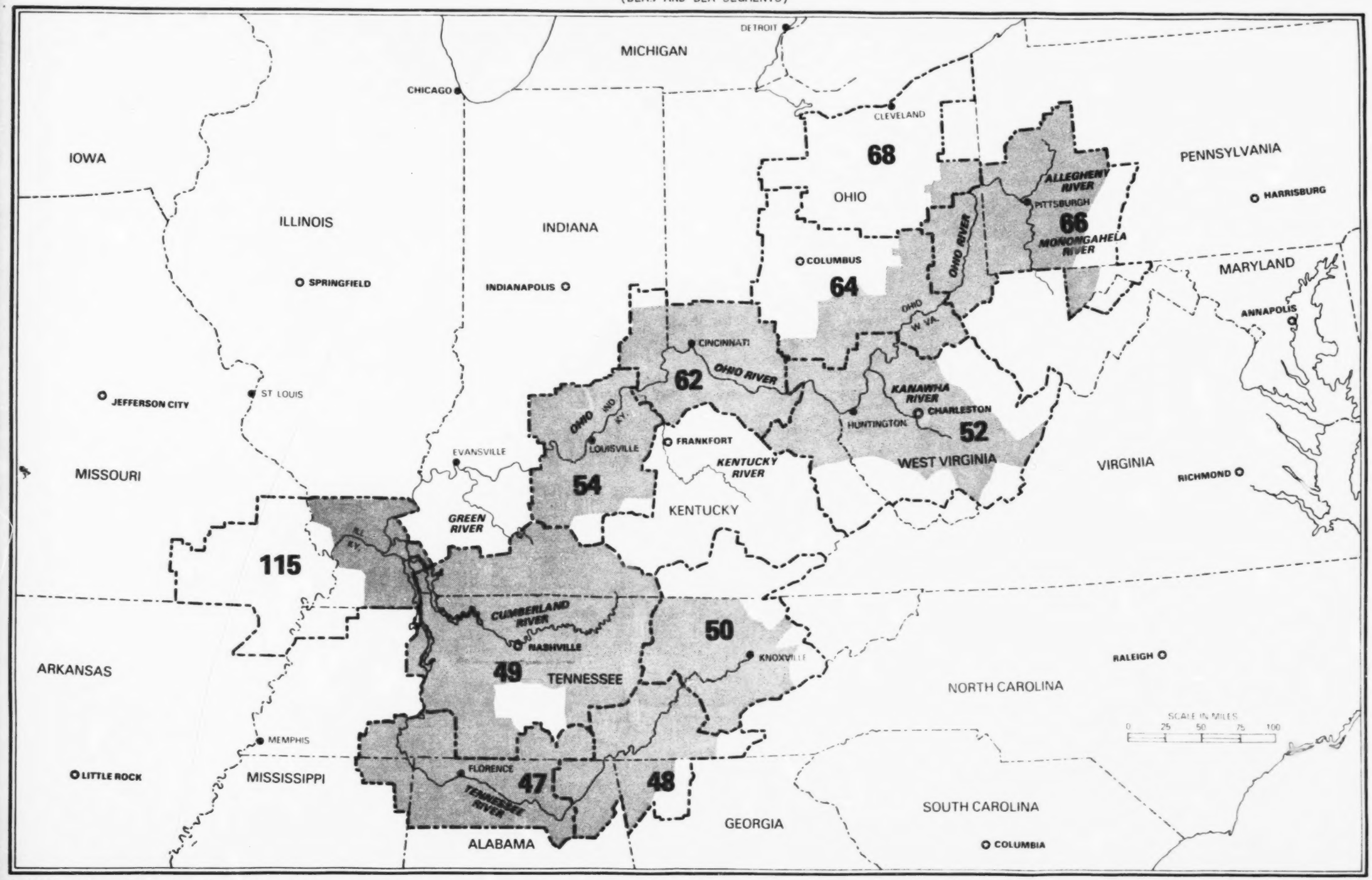
c. Growth rates are reported such that 1000 equals the index value reported in the third column.

Source: Robert R. Nathan Associates, Inc.

V. APPENDIX

BEST DOCUMENT AVAILABLE

MAP A-1. OHIO RIVER BASIN: PRIMARY STUDY AREAS FOR PETROLEUM PRODUCTS
(BEAs AND BEA SEGMENTS)



SOURCE: Robert R. Nathan Associates, Inc.

Primary Study Areas

Table A-1. Ohio River Basin: Primary Study Areas for Petroleum Products, Nec. (BEAs and BEA Segments)

BEA 47: Huntsville, AL
- Colbert, AL
- Franklin, AL
- Lauderdale, AL
- Lawrence, AL
- Limestone, AL
- Madison, AL
- Marshall, AL
- Morgan, AL
- Alcorn, MS
- Tishomingo, MS
- Franklin, TN
- Hardin, TN
- Lincoln, TN
- McNairy, TN
- Wayne, TN

BEA 48 (segment): Chattanooga, TN
- DeKalb, AL
- Jackson, AL
- Catoosa, GA
- Chattooga, GA
- Dade, GA
- Walker, GA
- Whitfield, GA
- Bledsoe, TN
- Bradley, TN
- Grundy, TN
- Hamilton, TN
- Marion, TN
- McMinn, TN
- Meigs, TN
- Polk, TN
- Rhea, TN
- Sequatchie, TN

BEA 49 (segment): Nashville, TN
- Allen, KY
- Barren, KY
- Butler, KY
- Christian, KY
- Clinton, KY
- Cumberland, KY
- Edmonson, KY
- Logan, KY
- Metcalfe, KY
- Monroe, KY
- Simpson, KY
- Todd, KY
- Trigg, KY
- Warren, KY
- Benton, TN
- Cannon, TN
- Cheatham, TN
- Clay, TN
- Coffee, TN
- Davidson, TN
- DeKalb, TN
- Dickson, TN
- Giles, TN
- Hickman, TN
- Houston, TN
- Humphreys, TN
- Jackson, TN
- Lawrence, TN
- Lewis, TN
- Macon, TN
- Maury, TN
- Montgomery, TN
- Overton, TN
- Perry, TN
- Pickett, TN
- Putnam, TN
- Robertson, TN
- Rutherford, TN
- Smith, TN
- Sumner, TN
- Stewart, TN
- Trousdale, TN
- Van Buren, TN
- White, TN
- Williamson, TN
- Wilson, TN

BEA 50 (segment): Knoxville, TN
- Anderson, TN
- Blount, TN
- Campbell, TN
- Cumberland, TN
- Fentress, TN
- Grainger, TN
- Jefferson, TN
- Knox, TN
- Loudon, TN
- Monroe, TN

(Continued)

Table A-1(Continued)

BEA 50 (segment): Knoxville, TN (cont.)
Morgan, TN
Roane, TN
Scott, TN
Sevier, TN
Union, TN

BEA 52 (segment); Huntington, WV
Boyd, KY
Carter, KY
Elliot, KY
Greenup, KY
Lawrence, KY
Rowan, KY
Gallia, OH
Lawrence, OH
Meigs, OH
Scioto, OH
Boone, WV
Cabell, WV
Clay, WV
Fayette, WV
Greenbrier, WV
Jackson, WV
Kanawha, WV
Lincoln, WV
Mason, WV
Nicholas, WV
Putnam, WV
Raleigh, WV
Roane, WV
Sumners, WV
Wayne, WV

BEA 54 (segment): Louisville, KY
Clark, IN
Crawford, IN
Floyd, IN
Harrison, IN
Jefferson, IN
Orange, IN
Scott, IN
Washington, IN
Breckenridge, KY
Bullitt, KY
Grayson, KY
Hardin, KY
Henry, KY

BEA 54 (segment): Louisville, KY (cont.)
Jefferson, KY
Meade, KY
Nelson, KY
Oldham, KY
Shelby, KY
Spencer, KY
Trimble, KY
Washington, KY

BEA 62 (segment): Cincinnati, OH
Dearborn, IN
Franklin, IN
Ohio, IN
Ripley, IN
Switzerland, IN
Boone, KY
Bracken, KY
Campbell, KY
Carroll, KY
Fleming, KY
Gallatin, KY
Grant, KY
Kenton, KY
Lewis, KY
Mason, KY
Owen, KY
Pendleton, KY
Robertson, KY
Adams, OH
Butler, OH
Brown, OH
Clermont, OH
Clinton, OH
Hamilton, OH
Highland, OH
Warren, OH

BEA 64 (segment): Columbus, OH
Athens, OH
Guernsey, OH
Hocking, OH
Jackson, OH
Morgan, OH
Noble, OH
Pike, OH
Vinton, OH
Washington, OH

(Continued)

Table A-1(Continued)

BEA 64 (segment): Columbus, OH (cont.)
Pleasants, WV
Ritchie, WV
Wirt, WV
Wood, WV

BEA 66 (segment): Pittsburgh, PA
Garrett, MD
Belmont, OH
Harrison, OH
Jefferson, OH
Monroe, OH
Allegheny, PA
Armstrong, PA
Beaver, PA
Butler, PA
Clarion, PA
Fayette, PA
Greene, PA
Indiana, PA
Washington, PA
Westmoreland, PA
Brooke, WV
Hancock, WV
Marshall, WV
Ohio, WV
Tyler, WV
Wetzel, WV

BEA 68 (segment): Cleveland, OH
Carroll, OH
Columbiana, OH

BEA 115 (segment): Paducah, KY
Hardin, IL
Johnson, IL
Massac, IL
Pope, IL
Pulaski, IL
Union, IL
Ballard, KY
Calloway, KY
Graves, KY
Livingston, KY
Lyon, KY
Marshall, KY
McCracken, KY

Source: Robert R. Nathan Associates, Inc.

VI. SOURCES AND REFERENCES

A. Reports and Publications

Howrey & Simon. Pipelines Owned by Oil Companies Provide A Pro-Competitive and Low Cost Means of Energy Transportation To The Nation's Industries and Consumers. Washington, D.C.: n.p., 1978.

"Future Refinery Capacity Needs, Construction Incentives and Processing Configuration." Oil & Gas Journal. 22 July 1977.

Indiana Department of Natural Resources. Geological Survey. Petroleum Industry in Indiana. Bulletin 42-N. By G.L. Carpenter, T.A. Dawson, S.J. Keller. Indiana: n.p., 1975.

McNeal, Bob. "1979 Forecast, 30,228.90 Miles of New Lines Planned Worldwide." Pipeline. Jan.-Feb. 1979, pp. 10-19.

Oak Ridge National Laboratory. Regional and Urban Studies Section. Energy Division Research. Energy Availabilities for State and Local Development: A Methodology and Data Overview. By P.L. Rice & D.P. Vogt. Sponsored by the Economic Development Administration of U.S. Department of Commerce. Oak Ridge, TN: ORNL, 1978.

Oak Ridge National Laboratory. Regional and Urban Studies Section. Energy Division Research. Energy Availability for State and Local Development: Projected Energy Patterns for 1980-1985. By D.P. Vogt, P.L. Rice, and V.P. Pai. Sponsored by the Economic Development Administration of U.S. Department of Commerce. Oak Ridge, TN: ORNL, 1978.

Robert R. Nathan Associates, Inc. Alaska North Slope Crude Oil: An Economic and Financial Assessment of Distributional Alternatives. Washington, D.C.: RRNA, 1978.

U.S. Army Corps of Engineers. Interstate Commerce Commission Railroad Waybill Sample. 1969, 1972 and 1976. Data provided on computer tape.

U.S. Army Corps of Engineers. Waterborne Commerce by Port Equivalents. 1969-76. Data provided on computer tape.

U.S. Department of Energy. Energy Information Administration. Energy Data Reports: Crude Petroleum, Petroleum Products, and Natural Gas Liquids. 1977 ed. Washington, D.C.: DOE, 1977.

U.S. Department of Energy. Energy Information Administration. Division of Consumption Data Studies. Federal Energy Data System (FEDS) Technical Documentation. By Raymond F. Fuller. Washington, D.C.: GPO, 1978.

U.S. Department of Energy. Assistant Secretary for Policy and Evaluation. Office of Policy Analysis. Petroleum Supply Alternatives for the Northern Tier and Inland States Through the Year 2000. Draft Report. Washington, D.C.: GPO, 1979. Vols. I and II.

U.S. Department of Energy. Energy Information Administration. Annual Report to Congress. 1977 ed. Washington, D.C.: GPO, 1978. Vols. II and III.

U.S. Department of the Interior. Bureau of Mines. "Crude Petroleum and Petroleum Products." Metals, Minerals, and Fuels. Vol. I of Minerals Yearbook. (Washington, D.C.: GPO, 1979.

U.S. Department of the Interior. Bureau of Mines. Mineral Facts and Problems. 1975 ed. Washington, D.C.: GPO, 1976.

B. Industrial Shippers and Receivers

Ashland Petroleum Company, Ashland, Kentucky.

Louisville and Nashville Railroad,
Birmingham, Alabama.

Marathan Oil, Inc., Louisville, Kentucky.

Shell Oil Company, Houston, Texas.

Triangle Refinery, Louisville, Kentucky.

C. Associations, Government Agencies and Educational Institutions

Commission on Energy and Environment, Charleston, West Virginia.

American Petroleum Institute, Washington, D.C.

Association of Oil Pipeline, Washington, D.C.

Branch of Petroleum Production and Processing, Department of Energy, Washington, D.C.

Bureau of Land Management, Department of the Interior, Washington, D.C.

Consumption Office, Energy Information Administration, Department of Energy, Washington, D.C.

Independent Petroleum Association, Washington, D.C.

Information Office, Federal Energy Regulatory Commission, Washington, D.C.

Mid-Continent Oil & Gas, Washington, D.C.

Oil Pipeline Board, Federal Energy Regulatory Commission, Department of Energy, Washington, D.C.

Office of Energy Data Interpretation, Department of Energy, Washington, D.C.

Office of Pipeline Safety, Department of Transportation, Washington, D.C.

Operation and Resource Allocation office, Department of Energy, Washington, D.C.

Pipeline, Houston, Texas.

Pipeline Producer Regulatory Office, Department of Energy, Special Assistant, Washington, D.C.

Sohio Petroleum Company, Washington, D.C.

Pipeline and Underground Utilities Construction, Houston, Texas.

People's Gas Company, Washington, D.C.